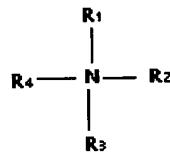


We claim:

1. A penetration composition for non-invasive translocation of at least one effector across a biological barrier, said composition comprising:
  - (a) a therapeutically effective amount of said effector;
  - (b) a counter ion to the effector; and
  - (c) a penetrating peptide.
2. The penetration composition of claim 1 further comprising a pharmaceutically acceptable excipient, pharmaceutically acceptable carrier, or a combination thereof.
3. The penetration composition of claim 1, wherein said composition is contained within a capsule.
4. The penetration composition of claim 1, wherein said composition is in the form of a tablet.
5. The penetration composition of claim 1, wherein said composition is enteric-coated.
6. The penetration composition of claim 1, wherein said composition is in the form selected from the group consisting of an aqueous dispersion, a suspension and an emulsion.
7. The penetration composition of claim 1, wherein said composition is in the form of a cream.
8. The penetration composition of claim 1, wherein said composition is in the form of an ointment.
9. The penetration composition of claim 1, wherein said composition is in the form of a suppository.
10. The penetration composition of claim 1, wherein said at least one effector is a cationic or an anionic impermeable molecule.
11. The penetration composition of claim 10, wherein said cationic or anionic impermeable molecule is a bioactive molecule.
12. The penetration composition of claim 10, wherein said anionic impermeable molecule is a polysaccharide.

13. The penetration composition of claim 12, wherein said polysaccharide is a glycosaminoglycan.
14. The penetration composition of claim 13, wherein said glycosaminoglycan is selected from the group consisting of: heparin; heparan sulfate; chondroitin sulfate; dermatan sulfate; hyaluronic acid and pharmaceutically acceptable salts thereof.
15. The penetration composition of claim 11, wherein said bioactive molecule is selected from the group consisting of: insulin; erythropoietin (EPO); glucagon-like peptide 1 (GLP-1);  $\alpha$ MSH; parathyroid hormone (PTH); growth hormone; calcitonin; interleukin-2 (IL-2);  $\alpha$ 1- antitrypsin; granulocyte/monocyte colony stimulating factor (GM-CSF); granulocyte colony stimulating factor (G-CSF); T20; anti- TNF antibodies; interferon  $\alpha$ ; interferon  $\beta$ ; interferon  $\gamma$ ; lutenizing hormone (LH); follicle- stimulating hormone (FSH); enkephalin; dalargin; kyotorphin; basic fibroblast growth factor (bFGF); hirudin; hirulog; lutenizing hormone releasing hormone (LHRH) analog; brain- derived natriuretic peptide (BNP); and neurotrophic factors.
16. The penetration composition of claim 1, wherein said at least one effector is a pharmaceutically active agent.
17. The penetration composition of claim 16, wherein said pharmaceutically active agent is selected from the group consisting of: a hormone, a growth factor, a neurotrophic factor, an anticoagulant, a bioactive molecule, a toxin, an antibiotic, an anti-fungal agent, an antipathogenic agent, an antigen, an antibody, an antibody fragment, an immunomodulator, a vitamin, an antineoplastic agent, an enzyme, and a therapeutic agent.
18. The penetration composition of claim 1, wherein said at least one effector is Caspofungin.
19. The penetration composition of claim 1, wherein said at least one effector is vitamin B12.
20. The penetration composition of claim 1, wherein said at least one effector is an aminoglycoside antibiotic.

21. The penetration composition of claim 20, wherein said aminoglycoside antibiotic is selected from the group consisting of Gentamycin, Amikacin, Tobramycin, and Neomycin.
22. The penetration composition of claim 1, wherein said effector is a nucleic acid or a nucleic acid mimetic.
23. The penetration composition of claim 22, wherein the nucleic acid is a DNA or DNA-mimetic.
24. The penetration composition of claim 22, wherein the nucleic acid is a RNA or RNA-mimetic.
25. The penetration composition of claim 1, wherein said counter ion is an anionic or cationic amphipathic molecule.
26. The penetration composition of claim 25, wherein said anionic amphipathic molecule is derived from a strong acid selected from the group consisting of sulfonate and phosphonate, and wherein said anionic amphipathic molecule further comprises a hydrophobic moiety.
27. The penetration composition of claim 25, wherein the counter anion is selected from the group consisting of: sodium dodecyl sulphate and dioctyl sulfosuccinate.
28. The penetration composition of claim 25, wherein said cationic amphipathic molecule is a quaternary amine comprising a hydrophobic moiety.
29. The penetration composition of claim 28, wherein said quaternary amine has the general structure of:



wherein R1, R2, R3 and R4 are alkyl or aryl residues.

30. The penetration composition of claim 29, wherein said quaternary amine is a benzalkonium derivative.
31. The penetration composition of claim 1, wherein said counter ion is an ionic liquid forming cation.

32. The penetration composition of claim 31, wherein said ionic liquid forming cation is selected from the group consisting of: imidazolium derivatives; pyridinium derivatives; phosphonium compounds; and tetralkylammonium compounds.
33. The penetration composition of claim 32, wherein said imidazolium derivative has the general structure of 1-R1-3-R2-imidazolium, wherein R1 and R2 are linear or branched alkyls with 1 to 12 carbons.
34. The penetration composition of claim 33, wherein said imidazolium derivatives further comprise a halogen or an alkyl group substitution.
35. The penetration composition of claim 32, wherein said imidazolium derivative is selected from the group consisting of: 1-ethyl-3-methylimidazolium; 1-butyl-3-methylimidazolium; 1-hexyl-3-methylimidazolium; 1-methyl-3-octylimidazolium; 1-methyl-3-(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl)-imidazolium; 1,3-dimethylimidazolium; and 1,2-dimethyl-3-propylimidazolium.
36. The penetration composition of claim 32, wherein said pyridinium derivative has the general structure of 1-R1-3-R2-pyridinium, wherein R1 is a linear or branched alkyl with 1 to 12 carbons, and R2 is H or a linear or branched alkyl with 1 to 12 carbons.
37. The penetration composition of claim 36, wherein said pyridinium derivatives further comprise a halogen or an alkyl group substitution.
38. The penetration composition of claim 32, wherein said pyridinium derivative is selected from the group consisting of 3-methyl-1-propylpyridinium, 1-butyl-3-methylpyridinium, and 1-butyl-4-methylpyridinium.
39. The penetration composition of claim 1, wherein said composition further comprises a polyanionic molecule.
40. The penetration composition of claim 39, wherein said polyanionic molecule is phytic acid.
41. The penetration composition of claim 1, further comprising a surface active agent.

42. The penetration composition of claim 41, wherein said surface active agent is selected from the group consisting of a poloxamer, Solutol HS15, Cremophore and bile acids.
43. The penetration composition of claim 1, wherein said composition is dissolved in an at least partially water soluble solvent.
44. The penetration composition of claim 43, wherein said at least partially water soluble solvent is selected from the group consisting of: n-butanol; isoamyl (=isopentyl) alcohol; iso-butanol; iso-propanol; propanol; ethanol; ter-butanol alcohols; polyols; DMF; DMSO; ethers; amides; esters; and mixtures thereof.
45. The penetration composition of claim 1, wherein any one or more of the components of the composition is lyophilized.
46. The penetration composition of claim 1, wherein said composition further comprises a hydrophobic carrier comprising at least one hydrophobic molecules, wherein said molecules are aliphatic, aromatic, or combinations thereof.
47. The penetration composition of claim 46, wherein said aliphatic hydrophobic molecules are selected from the group consisting of fatty acids, monoglycerides, di-glycerides, tri-glycerides, ethers, and cholesterol esters of fatty acids.
48. The penetration composition of claim 47, wherein said tri-glyceride is tricaprin.
49. The penetration composition of claim 46, wherein said aromatic hydrophobic molecule is benzyl benzoate.
50. The penetration composition of claim 1, further comprising at least one protective agent.
51. The penetration composition of claim 50, wherein said protective agent is a protease inhibitor selected from the group consisting of: aprotinin; Bowman-Birk inhibitor; soybean trypsin inhibitor; chicken ovomucoid; chicken ovoinhibitor; human pancreatic trypsin inhibitor; camostate mesilate; flavonoid inhibitors; antipain; leupeptin; *p*-aminobenzamidine;

AEBSF; TLCK; APMSF; DFP; PMSF; poly(acrylate) derivatives; chymostatin; benzyloxycarbonyl-Pro-Phe-CHO; FK-448; sugar biphenylboronic acids complexes;  $\beta$ -phenylpropionate; elastatinal; methoxysuccinyl-Ala-Ala-Pro-Val-chloromethylketone (MPCMVK); EDTA; chitosan-EDTA conjugates; amino acids; di-peptides; tripeptides; amastatin; bestatin; puromycin; bacitracin; phosphinic acid dipeptide analogues;  $\alpha$ -aminoboronic acid derivatives; Na-glycocholate; 1,10-phenanthroline; acivicin; L-serine-borate; thiophan; and phosphoramidon.

52. The penetration composition of claim 1, wherein the penetrating peptide comprises at least one amino acid sequence selected from the group consisting of:

- a)  $(BX)_4Z(BX)_2ZX;$
- b)  $ZBXB_2XBXB_2XBX_3BXB_2X_2B_2;$
- c)  $ZBZX_2B_4XB_3ZXB_4Z_2B_2;$
- d)  $ZB_9XBX_2B_2ZBXZBX_2;$
- e)  $BZB_8XB_9X_2ZXB;$
- f)  $B_2ZXZB_5XB_2XB_2X_2BZXB_2;$
- g)  $XB_9XBXB_6X_3B;$
- h)  $X_2B_3XB_4ZBXB_4XB_nXB;$
- i)  $XB_2XZBXZB_2ZBX_3BZBX_3B;$
- j)  $BZBXZBX_2B_4XBX_2B_2XB_4X_2;$
- k)  $BZBXZBX_2B_4XBX_2B_2XB_4;$
- l)  $B_2XZ_2XB_4XBX_2B_5X_2B_2;$
- m)  $B_qX_tZB_mX_qB_4XBX_nB_mZB_2X_2B_2;$
- n)  $B_2ZX_3ZB_mX_qB_4XBX_nB_mZB_2X_2B_2;$
- o)  $X_3ZB_6XBX_3BZB_2X_2B_2;$  and
- p) at least 12 contiguous amino acids of any of peptides a) through o)

wherein

q is 0 or 1;

m is 1 or 2;

n is 2 or 3;

t is 1 or 2 or 3; and

X is any amino acid;

B is a hydrophobic amino acid; and

Z is a charged amino acid;

wherein said penetrating peptide is capable of translocating across a biological barrier.

53. The penetration composition of claim 52, wherein the penetrating peptide comprises an amino acid sequence selected from the group consisting of:

- a) SEQ ID NOS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 24, 25, 26, 27, 28 and 29;
- b) a variant of an amino acid sequence selected from the group consisting of SEQ ID NOS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 24, 25, 26, 27, 28 and 29, wherein one or more amino acid residues in said variant differs from the amino acid sequence of said penetrating peptide, provided that said variant differs in no more than 15% of amino acid residues from said amino acid sequence;
- c) a fragment of an amino acid sequence selected from the group consisting of SEQ ID NOS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 24, 25, 26, 27, 28 and 29; and
- d) a peptide comprising at least 12 contiguous amino acids of any of the peptides selected from the group consisting of SEQ ID NOS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 24, 25, 26, 27, 28 and 29.

54. The penetration composition of claim 53, wherein the fragment is at least 10 amino acids in length.

55. The penetration composition of claim 53, wherein the amino acid sequence of said variant comprises a conservative amino acid substitution.

56. The penetration composition of claim 53, wherein the amino acid sequence of said variant comprises a non-conservative amino acid substitution.

57. The penetration composition of claim 53, wherein the penetrating peptide is further modified, via one or more peptidic bonds, to enable protection from gastrointestinal proteolysis.

58. The penetration composition of claim 57, wherein one or more amino acid residues in said variant is replaced by a non-naturally occurring amino acid, selected from the group consisting of: D-amino acids; norleucine; norvaline; homocysteine; homoserine; ethionine; and compounds derivatized with an amino-terminal blocking group including *t*-butyloxycarbonyl, acetyl, methyl, succinyl, methoxysuccinyl, suberyl, adipyl, azelayl, dansyl, benzyloxycarbonyl, fluorenylmethoxycarbonyl, methoxyaselayl, methoxyadipyl, methoxysuberyl, and a 2,3-dinitrophenyl group.
59. The penetration composition of claim 57, wherein one or more peptide bonds have been replaced with an alternative type of covalent bond to form a peptide mimetic.
60. The penetration composition of claim 52, wherein the penetrating peptide is the peptide of SEQ ID NO: 3 or at least 12 contiguous amino acids thereof.
61. The penetration composition of claim 52, wherein the penetrating peptide is the peptide of SEQ ID NO: 8 or at least 12 contiguous amino acids thereof.
62. The penetration composition of claim 52, wherein the penetrating peptide is the peptide of SEQ ID NO: 9 or at least 12 contiguous amino acids thereof.
63. The penetration composition of claim 52, wherein the penetrating peptide is the peptide of SEQ ID NO: 12 or at least 12 contiguous amino acids thereof.
64. The penetration composition of claim 52, wherein penetrating peptide is the peptide of SEQ ID NO: 24 or at least 12 contiguous amino acids thereof.
65. The penetration composition of claim 52, wherein the penetrating peptide is less than 30 amino acids long.
66. The penetration composition of claim 52, wherein the penetrating peptide is less than 25 amino acids long.
67. The penetration composition of claim 52, wherein the penetrating peptide is less than 20 amino acids long.
68. The penetration composition of claim 52, wherein said penetrating peptide further contains lysine residues, interspaced by glycine, alanine or serine residues, added at the C-terminus of the penetrating peptide, and wherein the free amino groups of said lysine residues are acylated.

69. The penetration composition of claim 68, wherein acylation utilizes long-chain fatty acids selected from the group of: stearoyl, palmitoyl, oleyl, ricinoleyl, lauroyl and myristoyl.

70. The penetration composition of claim 68, wherein the amino acid sequence of the penetrating peptide is selected from the group consisting of:

- SEQ ID NOS: 22, 30, 31, 32, 33, 34, 35, 36, and 37;
- a variant of an amino acid sequence selected from the group consisting of SEQ ID NOS: 22, 30, 31, 32, 33, 34, 35, 36, and 37, wherein one or more amino acid residues in said variant differs from the amino acid sequence of said penetrating peptide, provided that said variant differs in no more than 15% of amino acid residues from said amino acid sequence;
- a fragment of an amino acid sequence selected from the group consisting of SEQ ID NOS: 22, 30, 31, 32, 33, 34, 35, 36, and 37; and
- a peptide comprising at least 12 contiguous amino acids of any of the peptides selected from the group consisting of SEQ ID NOS: 22, 30, 31, 32, 33, 34, 35, 36, and 37.

71. A method of translocating at least one effector across a biological barrier comprising:

- introducing the penetration composition of claim 1 to a biological barrier; and
- allowing said penetration composition to translocate across said biological barrier,

thereby translocating the at least one effector across the biological barrier.

72. The method of claim 71, wherein the penetration composition of (a) comprises a penetrating peptide of claim 52.

73. The method of claim 70, wherein the penetration composition of (a) comprises a penetrating peptide of claim 68.

74. The method of claim 71, wherein the penetrating peptide of the penetration composition is selected from the group consisting of SEQ ID NO: 22, 30, 31, 32, 33, 34, 35, 36, and 37.
75. The method of claim 71, wherein the translocation across a biological barrier occurs within a tissue selected from the group consisting of: epithelial cells and endothelial cells.
76. The method of claim 75, wherein said biological barrier is selected from the group consisting of: tight junctions and plasma membrane.
77. The composition of claim 2, wherein the composition further comprises a mixture of at least two substances selected from the group consisting of a non-ionic detergent, an ionic detergent, a protease inhibitor, and a reducing agent.
78. The composition of claim 77, wherein the non-ionic detergent is a poloxamer or Solutol HS15.
79. The composition of claim 78, wherein the poloxamer is pluronic F-68.
80. The composition of claim 77, wherein the ionic detergent is a bile salt.
81. The composition of claim 80, wherein the bile salt is Taurodeoxycholate.
82. The composition of claim 77, wherein the protease inhibitor is selected from the group consisting of: aprotinin; Bowman-Birk inhibitor; soybean trypsin inhibitor; chicken ovomucoid; chicken ovoinhibitor; human pancreatic trypsin inhibitor; camostate mesilate; flavonoid inhibitors; antipain; leupeptin; *p*-aminobenzamidine; AEBSF; TLCK; APMSF; DFP; PMSF; poly(acrylate) derivatives; chymostatin; benzylloxycarbonyl-Pro-Phe-CHO; FK-448; sugar biphenylboronic acids complexes;  $\beta$ -phenylpropionate; elastatinal; methoxysuccinyl-Ala-Ala-Pro-Val-chloromethylketone (MPCMk); EDTA; chitosan-EDTA conjugates; amino acids; dipeptides; tripeptides; amastatin; bestatin; puromycin; bacitracin; phosphinic acid dipeptide analogues;  $\alpha$ -aminoboronic acid derivatives; Na-glycocholate; 1,10-phenanthroline; acivicin; L-serine-borate; thiophan; and phosphoramidon.
83. The composition of claim 77, wherein the reducing agent is NAC.

84. A method of producing the penetration composition of claim 1, said method comprising coupling a therapeutically effective amount of the at least one effector with a penetrating peptide and a counter ion to the at least one effector.

85. The method of claim 84, wherein the coupling of said at least one effector and said penetrating peptide is achieved by a non-covalent bond.

86. The method of claim 85, wherein the non-covalent bond is achieved by an attachment of a hydrophobic moiety to the penetrating peptide, wherein the hydrophobic moiety enables the penetrating peptide to be incorporated at the interface of a hydrophobic vesicle in which the at least one effector is contained.

87. A method of translocating at least one effector across a biological barrier, said method comprising:

- coupling said at least one effector with a counter ion and a penetrating peptide to form a penetration composition; and
- introducing said penetration composition to the biological barrier.

88. A method of mucosal vaccination, the method comprising administering to a subject in need of vaccination the penetration composition of claim 1, wherein the at least one effector comprises an antigen to which vaccination is desired.

89. The method of claim 88, wherein the antigen to which vaccination is desired is selected from the group consisting of PA for use in a vaccine against Anthrax, and HBs for use in a vaccine against Hepatitis B.

90. A kit comprising, in one or more containers, a therapeutically or prophylactically effective amount of the composition of claim 2.

91. A method of treating or preventing a disease or pathological condition, said method comprising administering to a subject in which such treatment or prevention is desired, the composition of claim 2, in an amount sufficient to treat or prevent said disease or said pathological condition in said subject.

92. The method of claim 91, wherein said disease or said pathological condition is selected from the group consisting of: endocrine disorders; diabetes;

infertility; hormone deficiencies; osteoporosis; neurodegenerative disorders; Alzheimer's disease; dementia; Parkinson's disease; multiple sclerosis; Huntington's disease; cardiovascular disorders; atherosclerosis; hyper- and hypocoagulable states; coronary disease; cerebrovascular events; metabolic disorders; obesity; vitamin deficiencies; renal disorders; renal failure; haematological disorders; anemia of different entities; immunologic and rheumatologic disorders; autoimmune diseases; immune deficiencies; infectious diseases; viral infections; bacterial infections; fungal infections; parasitic infections; neoplastic diseases; multi-factorial disorders; impotence; chronic pain; depression; different fibrosis states; and short stature.

93. An isolated peptide comprising an amino acid sequence selected from the group consisting of SEQ ID NOS: 1-8, 10-15, and 25-29, wherein said peptide is derived from a bacterial protein, and wherein said peptide is characterized by the ability to penetrate biological barriers *in vivo*.
94. The peptide of claim 93, wherein the peptide is derived from an integral membrane protein.
95. The peptide of claim 93, wherein the peptide is derived from a bacterial toxin.
96. The peptide of claim 93, wherein the peptide is derived from an extracellular protein.
97. An isolated peptide comprising an amino acid sequence selected from the group consisting of SEQ ID NOS:9 and 24, wherein said peptide is derived from a human neurokinin receptor, and wherein said peptide is characterized by the ability to penetrate biological barriers *in vivo*.
98. A method for producing the penetration composition of claim 1, the method comprising synthesizing the penetrating peptide using solid-phase synthesis, and coupling the penetrating peptide to at least one effector and a counter ion to the effector.
99. The penetration composition of claim 1, wherein said penetrating peptide further comprises a chemical modification.

100. The penetration composition of claim 99, wherein said at least one effector is selected from the group consisting of: insulin; erythropoietin (EPO); glucagon-like peptide 1 (GLP-1);  $\alpha$ MSH; parathyroid hormone (PTH); growth hormone; calcitonin; interleukin-2 (IL-2);  $\alpha$ 1- antitrypsin; granulocyte/monocyte colony stimulating factor (GM-CSF); granulocyte colony stimulating factor (G-CSF); T20; anti- TNF antibodies; interferon  $\alpha$ ; interferon  $\beta$ ; interferon  $\gamma$ ; lutenizing hormone (LH); follicle- stimulating hormone (FSH); enkephalin; dalargin; kyotorphin; basic fibroblast growth factor (bFGF); hirudin; hirulog; lutenizing hormone releasing hormone (LHRH) analog; brain-derived natriuretic peptide (BNP); and neurotrophic factors.

101. The penetration composition of claim 99, wherein the chemical modification comprises the attachment of one or more polyethylene glycol residues to the penetrating peptide.